AMENDMENTS TO THE SPECIFICATION

Please replace the headings and paragraphs starting on page 1, line 6 (numbered line 8) and ending on page 3, line 20 (numbered line 21) with the following:

BACKGROUND ~~OF THE INVENTION~~

~~1. Field of the Invention~~

~~The present~~ Embodiments of the present invention relate ~~relates~~ to a heat exchanger ~~and, more specifically, to a heat exchanger including a downsized inlet manifold and a downsized outlet manifold~~.

~~2. Description of the Related Art~~

~~As a conventional heat exchanger, known is the heat exchanger disclosed in~~ Published Japanese Translation of PCT International Application No. 2001 – 525051 discloses a conventional heat exchanger 50. In FIGs. 1 to 5, the lateral, longitudinal and height directions of the heat ~~a heat~~ exchanger 50 are defined as X, Y and Z axes, respectively. The X, Y and Z axes are orthogonal to one another. As shown in FIG. 1, the heat exchanger 50 includes tubes 51, corrugated fins 52, a pair of header pipes 53, an inlet manifold 54, an outlet manifold 55, and a pair of blocking caps 56. The plurality of tubes 51 are arranged along the X axis mutually in parallel and at even intervals. Each of the plurality of corrugated fins 52 is disposed between two adjacent tubes 51. The pair of header pipes 53 house both ends of the plurality of tubes 51. The inlet manifold 54 is fixed to one end of one of the header ~~pipe 53~~ pipes 53 on a –X side. The outlet manifold 55 is fixed to one end of the other header pipe 53 on a +X side. The pair of blocking caps 56 block the respective other ends of the pair of header pipes 53.

The heat exchanger 50 causes a first fluid flowing in from the inlet manifold 54 to circulate along a given passage formed ~~of the~~ by the header pipes 53 and the tubes 51. In the heat exchanger 50, heat exchange takes place efficiently between the first fluid passing inside the tubes 51 and a second fluid passing outside the tubes 51.

In the heat exchanger 50, as shown in FIGs. 2 and 3, four parallel fluid circulation holes 57 are formed~~, in parallel,~~ inside each header pipe 53 along a longitudinal direction of the header pipe ~~53, and a~~ 53. A plurality of parallel tube insertion holes 58 are formed along a lateral direction of the header pipe 53 ~~in parallel~~. The fluid circulation holes 57 and the tube insertion holes 58 are orthogonal to one another. One end of each ~~ends~~ of the tube

insertion holes 58 penetrates ~~penetrate~~ through an outer side surface 53a of the associated ~~each~~ header pipe 53 and ~~are opened~~ opens to the outside ~~of each header pipe 53~~ thereof. Both end portions of the tubes 51 are inserted into the tube insertion holes 58 and are fixed to the header pipes 53 by brazing or the like.

As shown in FIG. 4, at an upper end portion of the header pipe 53 on the –X side, the fluid circulation holes 57 ~~are opened~~ open to an inlet hole 54a of the inlet manifold 54. In order to connect the header pipe 53 on the –X side to the inlet manifold 54, a manifold side connection hole 54b, which has ~~having~~ the same shape as the upper end portion of the header pipe 53 on the –X side, is ~~side is~~ formed on a lower surface of the inlet manifold 54. The upper end portion of the header pipe 53 on the –X side is inserted into the manifold side connection hole 54b of the inlet manifold 54 and is fixed to the inlet manifold 54 by brazing or the like. Moreover, the header pipes 53 are fixed to the outlet manifold 55 and the blocking caps 56 in a similar manner.

When the heat exchanger 50 is manufactured as previously described ~~above~~, in order to insert the upper end portion of the header pipe 53 on the –X side directly into the inlet manifold 54, the manifold side connection hole 54b (which has ~~having~~ the same shape as the upper end portion of the header pipe 53 on the –X side) is ~~side is~~ formed on the lower surface of the inlet manifold 54. Therefore, as shown in FIG. 5, in a cross section parallel to an X-Y plane, the area of the inlet manifold 54 is ~~is to be~~ greater than the area of the upper end portion of the header pipe 53 on the –X side. Similarly, manifold side connection holes (not shown), which have ~~having~~ the same shapes as the end portions of the header pipes ~~53 are~~ 53, are also formed on the outlet manifold 55 and the blocking caps 56. Accordingly, in the cross section parallel to the X-Y plane, the areas of the outlet manifold 55 and the blocking caps 56 are each ~~become~~ greater than the areas of the respective end portions of the header pipes 53. Therefore, the inlet manifold 54, the outlet manifold 55, and the blocking caps 56 are each ~~formed~~ larger than the respective end portions of the header pipes 53, thereby increasing the size of ~~incurring an increase in size of~~ the heat exchanger 50 and correspondingly impairing the ease by which ~~difficulty in handling~~ the heat exchanger 50 is handled.

SUMMARY ~~OF THE INVENTION~~

Please replace the paragraphs and the heading on page 4, line 23 (numbered line 24) – page 6, line 5 (numbered line 6) with the following:

FIG. 3 is a front view of a header pipe in the conventional heat exchanger shown in FIG. 1.

FIG. 4 is an X-Z sectional view of a connection point between the header pipe and an inlet manifold in the conventional heat exchanger shown in FIG. 1.

FIG. 5 is an X-Y sectional view of the connection point ~~between the header pipe and the inlet manifold in the conventional heat exchanger~~ of FIG. 4.

FIG. 6A is a plan view of a heat exchanger according to a first embodiment of the present invention.

FIG. 6B is a front view of the heat exchanger shown in FIG. 6A.

FIG. 6C is a side view of the heat exchanger shown in FIG. 6A.

FIG. 7A is a sectional view of a connection point between a header pipe and an inlet manifold ~~in the first embodiment~~ of the heat exchanger shown in FIGS. 6A-6C.

FIG. 7B is an exploded perspective view of the connection point ~~between the header pipe and the inlet manifold~~ shown in FIG. 7A.

FIG. 8A is a sectional view of a connection point between the header pipe and an outlet manifold ~~in the first embodiment~~ of the heat exchanger shown in FIGS. 6A-6C.

FIG. 8B is an exploded perspective view of the connection point ~~between the header pipe and the outlet manifold~~ shown in FIG. 8A.

FIG. 9 is an exploded perspective view of a connection point between a header pipe and an inlet manifold (or an outlet manifold) in a second embodiment of the present invention.

FIG. 10 is an exploded perspective view of a connection point between a header pipe and an inlet manifold (or an outlet manifold) in a third embodiment of the present invention.

FIG. 11 is an exploded perspective view of a connection point between a header pipe and an inlet manifold (or an outlet manifold) in a fourth embodiment of the present invention.

FIG. 12 is an exploded perspective view of a connection point between a header pipe and an inlet manifold (or an outlet manifold) in a fifth ~~the other~~ embodiment of the present invention.

FIG. 13 is an exploded perspective view of a connection point between the header pipe and the inlet manifold (or an outlet manifold) in a sixth ~~the other~~ embodiment of the present invention.

DETAILED DESCRIPTION ~~OF THE PREFERRED EMBODIMENTS~~

Please replace the paragraphs on page 6, line 11 (numbered line 13) – page 7, line 12 with the following:

As shown in FIGs. 6A to 6C, a heat exchanger 1 includes tubes 2, corrugated fins 3, an upper header pipe 4a, a lower header pipe 4b, two sets of coupling members 5a, 5b, 5c, and 5d, an inlet manifold 6, an outlet manifold 7, and blocking caps 8. The plurality of tubes 2 are arranged along the Z axis mutually in parallel and at even intervals. The plurality of corrugated fins 3 are each disposed between two adjacent tubes 2 along the X axis (which are only partially illustrated in FIG. 6B). The upper header pipe 4a houses ~~one ends~~ one (i.e., first) end (+Z side) of each of the tubes 2. The lower header pipe 4b houses the other ~~ends~~ (i.e., second) end (–Z side) of each of the tubes 2. The inlet manifold 6 is fixed to ~~one end~~ a first end (+X side) of the upper header pipe 4a through the coupling members 5a, 5b, 5c, and 5d. The outlet manifold 7 is fixed to ~~the other~~ a second end (–X side) of the upper header pipe 4a through other coupling members 5a, 5b, 5c, and 5d. The blocking caps 8 separately block both ends of the lower header pipe 4b.

Each tube 2 is made of an aluminum material (such as A1050) and ~~formed~~ is formed into a flat plate shape. A plurality of circulation holes (not shown) with openings at both ends are formed inside each tube 2. The plurality of circulation holes are arranged along the Z axis mutually in parallel. The first ends ~~one ends~~ (+Z side) of the tubes 2 are inserted into upper tube insertion holes (not shown) of the upper header pipe 4a and are fixed to the upper header pipe 4a by brazing. The second ~~other~~ ends (–Z side) of the tubes 2 are inserted into lower tube insertion holes (not shown) of the lower header pipe 4b and are fixed to the lower header pipe 4b by brazing.

Each corrugated fin 3 is made of an aluminum material (such as A3003) and ~~formed~~ is formed into a corrugated shape. Each corrugated film 3 is fixed between two adjacent tubes 2 by brazing.

Please replace the paragraph on page 8, line 14 – page 9, line 7 with the following:

The first set of coupling members 5a, 5b, 5c, and 5d disposed on the ~~one end~~ first end (+X side) of the upper header pipe 4a are formed into cylindrical shapes of the same size. Diameters of the manifold side connection holes 13a, 13b, 13c, and 13d are the same as diameters of the first set of coupling members 5a, 5b, 5c, and 5d, respectively. Diameters of the pipe side connection holes 17a, 17b, 17c, and 17d are the same as the diameters of the first set of coupling members 5a, 5b, 5c, and 5d, respectively. Coupling holes 16a, 16b, 16c, and 16d are formed inside the first set of coupling members 5a, 5b, 5c, and 5d, respectively. One (i.e., first) end ~~ends~~ (–X side) of each of the coupling members 5a, 5b, 5c and 5d is inserted ~~are inserted~~ into the pipe side connection holes 17a, 17b, 17c and 17d, respectively. The other (i.e., second) end ~~ends~~ (+X side) of each of the coupling members 5a, 5b, 5c and 5d is inserted ~~are inserted~~ into the manifold side connection holes 13a, 13b, 13c and 13d, respectively. The upper header pipe 4a is connected to the inlet manifold 6 through the first set of coupling members 5a, 5b, 5c, and 5d. The first set of coupling members 5a, 5b, 5c, and 5d are fixed to the upper header pipe 4a and the inlet manifold 6 by brazing. The fluid circulation holes 10a, 10b, 10c, and 10d communicate with the inlet hole 12 of the inlet manifold 6 through the coupling holes 16a, 16b, 16c, and 16d. Diameters of the coupling holes 16a, 16b, 16c, and 16d are gradually reduced toward the +Y direction, in other words, starting from an inlet portion 6a of the inlet manifold 6.

Please replace the paragraphs on page 9, line 17 – page 11, line 6 with the following:

The second set of coupling members 5a, 5b, 5c, and 5d disposed on the second ~~other~~ end (–X side) of the upper header pipe 4a are formed into cylindrical shapes of the same size. Diameters of the manifold side connection holes 15a, 15b, 15c, and 15d are the same as the diameters of the second set of coupling members 5a, 5b, 5c, and 5d, respectively. Diameters of the pipe side connection holes 18a, 18b, 18c, and 18d are the same as the diameters of the second set of coupling members 5a, 5b, 5c, and 5d, respectively. Coupling holes 16a, 16b, 16c, and 16d are formed inside the second set of coupling members 5a, 5b, 5c, and 5d, respectively. One (i.e., first) end ~~ends~~ (+X side) of each of the coupling members 5a, 5b, 5c and 5d is inserted ~~are inserted~~ into the pipe side connection holes 18a, 18b, 18c and 18d,

respectively. The other (i.e., second) end ~~ends~~ (–X side) of each of the coupling members 5a, 5b, 5c and 5d is inserted ~~are inserted~~ into the manifold side connection holes 15a, 15b, 15c and 15d, respectively. The upper header pipe 4a is connected to the outlet manifold 7 through the second set of coupling members 5a, 5b, 5c, and 5d. The second set of coupling members 5a, 5b, 5c, and 5d are fixed to the upper header pipe 4a and the outlet manifold 7 by brazing. The fluid circulation holes 10a, 10b, 10c, and 10d communicate with the outlet hole 14 of the outlet manifold 7 through the coupling holes 16a, 16b, 16c, and 16d. The diameters of the coupling holes 16a, 16b, 16c, and 16d are gradually reduced toward the +Y direction, in other words, starting from an outlet portion 7a of the outlet manifold 7.

A first fluid flowing inside the heat exchanger 1 travels from the inlet manifold 6 to the outlet manifold 7 via the following pathway: the first set of coupling members 5a, 5b, 5c, and 5d; the +X side portion of the upper header pipe 4a; the tubes 2 located below the +X side portion of the upper header pipe 4a; the lower header pipe 4b; the tubes 2 located below the -X side portion of the upper header pipe 4a; the -X side portion of the upper header pipe 4a; and the second set of ~~other~~ coupling members 5a, 5b, 5c, and 5d. In the heat exchanger 1, heat exchange mainly takes place between the first fluid passing inside the tubes 2 and a second fluid passing outside the tubes 2 efficiently.

The heat exchanger 1 of the above-described configuration has the following ~~characteristics~~ advantages.

As ~~Since~~ the upper header pipe 4a is connected to the inlet manifold 6 and the outlet manifold 7 through the first and second sets of coupling members 5a, 5b, 5c, and 5d, it is not necessary to form the manifold side connection holes ~~to be formed~~ on the inlet manifold 6 and the outlet manifold 7 in the same shapes as the end portions of the upper header pipe 4a. Therefore, in a cross-section parallel to a Y-Z plane, the area of the inlet manifold 6 or the output manifold 7 becomes the same as or smaller than the area of the end portion of the upper header pipe 4a. As a result, it is possible to downsize the inlet manifold 6 and the output manifold 7, and thereby to downsize the heat exchanger 1.